4

Distribution of Microbial Bioaerosol

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4.1. Introduction

Although the atmosphere forms a continuous bioaerosol transport medium between indoor and outdoor air, barriers occur that hinder airflow. Because of these hinderances, it has been assumed that it is adequate to study these two environments separately. As more is learned about both populations, this assumption may need to be changed.

In the past, the distribution of outdoor viable droplet/particles (D/P) in urban and rural atmospheric environments seemed chaotic. Presumably because they could not be seen, and when sampled, their concentration variation within and among collection sites was very large. With the development of viable D/P samplers such as the slit and cascade impactors (see Chapter 6), and airplane-borne devices (Timmons et al., 1966), a much better understanding of the microscale and mesoscale distribution patterns of viable bioaerosols is emerging. Presently, the dynamic processes that contribute to the airborne concentration or standing stock (i.e., the concentrations during a sampling time period of viable bioaerosols) are being elucidated.

A notion used to help understand the viable D/P distribution patterns in the atmosphere is their colony count balance in an imaginary static unit air volume through which an airstream passes. Figure 4.1 shows such a unit air volume where D/Ps are entrained into the atmosphere from some source(s) at some influent flux (number of D/Ps m^{-2} s^{-1}) to an air volume, and lost from that volume at some effluent flux. The concentration at any instant is the summation of those two fluxes. The effluent flux may be due to many factors, including meteorological processes such as advective and convective turbulence, physical process such as gravitational settling and agglomeration, and/or biological processes such as death and repair damage.
Because of the continuous motion of the atmosphere, the sources and sinks of bioaerosols may be great distances and times apart. A bioaerosol cloud would be thought of as D/Ps added and removed by the aforementioned process, while at the same time being turbulently mixed on various scales as well as advectively (i.e., movement of the air mass within which turbulent eddies exist) transported by the atmosphere.

### 4.2. Extramural (Outdoor) Bioaerosol Distributions

#### 4.2.1. Quality of Microbial Bioaerosols

The species of an extramural airborne microorganism that might be found in an air sample at any particular location depends on (a) the species that can and do escape from a source, (b) their survival characteristics in the prevailing meteorological conditions, and (c) the travel time (or distance, which is the product of the wind speed and travel time) from the source. Air samples taken downwind near a source will tend to have all of the kinds of microorganisms that are found on the source. Farther downwind, a more “hardy” population will be selected. Those that remain, are able to survive the prevailing atmospheric conditions. Tables 4.1 and 4.2 list the surviving bacteria and fungi found in the air at several locations. The most prevalent bacteria (found in 50–95% of the samples) were Gram-positive cocci in the genera Micrococcus, Sarcina, and Staphlococcus, and occasionally Coryneforms. Among the Gram-negative bacte-